We claim:

1. A sputtering apparatus for use in a vacuum chamber comprising:

ion source means for generating ions with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a material, upon which said ion efflux is directed, wherefrom said material is sputtered, with means for applying to each of said targets a negative bias relative to ground, with said targets located relative to said substrate and said biases of said targets controlled so as to generate a deposition of said material on said substrate having a thickness wherein said thickness has a predetermined distribution.

2. Apparatus in accordance with Claim 1 further comprising a plurality of sensors for providing measurements of said thickness of said deposition at a plurality of locations on or near said substrate and wherein comparisons of said measurements are used to control said biases of said targets during deposition.

3. A sputtering apparatus for use in a vacuum chamber comprising:

ion source means for generating ions with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a plurality of materials, upon which said ion efflux is directed, wherefrom material is sputtered, with a plurality of means for applying to said targets negative biases relative to ground, with said biases controlled such that a predetermined composition of said materials from said targets is deposited on said substrate.

4. A sputtering apparatus for use in a vacuum chamber comprising:

ion source means for generating ions with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a plurality of materials, upon which said ion efflux is directed, wherefrom material is sputtered, with a plurality of means for applying to said targets negative biases relative to ground, with said biases controlled in a time-sequential manner such that layers of different compositions of said materials are deposited sequentially on said substrate.

5. A sputtering apparatus for use in a vacuum chamber comprising:

ion source means for generating ions with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a plurality of materials, upon which said ion efflux is directed, wherefrom material is sputtered, with a plurality of means for applying to said targets negative biases relative to ground, with said biases varied in a time-varying manner so that the deposit on said substrate varies in a continuous manner from an initial composition comprised of respective said target materials to a following and different composition comprised of said materials.

6. An ion-beam deposition apparatus for operation in a vacuum chamber comprising:

a plurality of ion-source means for generating a plurality of ion beams, wherein each ion beam has an ion energy and an ion current with said ion energy and ion current independently controllable;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a material, upon which said ion beams are directed, wherefrom said material is sputtered, with said targets located relative to said substrate and said ion energies and said ion currents of said ion beams controlled so as to generate a deposition of said material on said substrate having a thickness wherein said thickness has a predetermined distribution.

7. Apparatus in accordance with Claim **6** further comprising a plurality of sensors for providing measurements of said thickness of said deposition at a plurality of locations on or near said substrate and wherein comparisons of

said measurements are used to control said ion energies and said ion currents during deposition.

8. An ion-beam deposition apparatus for operation in a vacuum chamber comprising:

a plurality of ion-source means for generating a plurality of ion beams, wherein each ion beam has an ion energy and an ion current with said ion energy and ion current independently controllable;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a plurality of materials, upon which said ion beams are directed, wherefrom material is sputtered, with said ion energies and said ion currents of said ion beams controlled in a time-sequential manner such that layers of different compositions of said materials are deposited sequentially on said substrate.

9. An ion-beam deposition apparatus for operation in a vacuum chamber comprising:

a plurality of ion-source means for generating a plurality of ion beams, wherein each ion beam has an ion energy and an ion current with said ion energy and ion current independently controllable;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a plurality of materials, upon which said ion beams are directed, wherefrom material is sputtered, with said ion beams controlled in a time-varying manner such that the deposit on

said substrate varies in a continuous manner from an initial composition comprised of respective said target materials to a following and different composition comprised of said materials.

10. A sputtering apparatus for use in a vacuum chamber comprising:

a plurality of ion source means for generating ions, each with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less and wherein said efflux has an ion current that is independently controllable;

at least one deposition substrate; and

a plurality of stationary sputter targets, upon which said ion effluxes are directed, wherefrom material is sputtered, with means for applying to each of said targets a negative bias relative to ground, with said targets located relative to said substrate and said ion currents of said ion sources and said negative biases of said targets controlled so as to generate a deposition of said material on said substrate having a thickness wherein said thickness has a predetermined distribution.

11. Apparatus in accordance with Claim **10** further comprising a plurality of sensors for providing measurements of said thickness of said deposition at a plurality of locations on or near said substrate and wherein comparisons of said measurements are used to control said ion currents of said sources and said biases of said targets during deposition.

12. A sputtering apparatus for use in a vacuum chamber comprising:

a plurality of ion source means for generating ions, each with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less and wherein said efflux has a total ion current that is independently controllable;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a plurality of materials, upon which said ion efflux is directed, wherefrom material is sputtered, with means for applying to each of said targets a negative bias relative to ground, with said ion currents of said ion sources and said negative biases of said targets controlled so as to generate a predetermined composition of the deposition on said substrate comprised of respective materials or combinations of materials from said targets.

13. A sputtering apparatus for use in a vacuum chamber comprising:

a plurality of ion source means for generating ions, each with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less and wherein said efflux has a total ion current that is independently controllable;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a plurality of materials, upon which said ion efflux is

directed, wherefrom material is sputtered, with means for applying to each of said targets a negative bias relative to ground, with said ion currents of said ion sources and said biases of said targets controlled so as to generate a predetermined layered deposition on said substrate with respective layers comprised of respective materials or combinations of materials from said targets.

14. A sputtering apparatus for use in a vacuum chamber comprising:

a plurality of ion source means for generating ions, each with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less and wherein said efflux has a total ion current that is independently controllable;

at least one deposition substrate; and

a plurality of stationary sputter targets comprised of a plurality of materials, upon which said ion efflux is directed, wherefrom material is sputtered, with means for applying to each of said targets a negative bias relative to ground, with said ion currents of said ion sources and said biases of said targets controlled so as to generate a predetermined graded deposition on said substrate with said deposition changing from one composition comprised of respective said target materials to another composition comprised of said materials.

15. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing an ion source means capable of generating ions with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets;

(d) biasing each of said targets negative relative to ground;

(e) directing said ion efflux upon said targets so as to sputter material therefrom; and

(f) locating said substrate relative to said targets and controlling said biases so as to deposit upon said substrate a film of said material having a thickness with a predetermined thickness distribution.

16. A method in accordance with claim **15** comprising the further steps of:

(g) locating a plurality of sensors to provide measurements of said thickness at a plurality of locations on or near said substrate;

(h) making comparisons of said measurements of said thickness; and

(i) using said comparisons to control said biases of said substrates.

17. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing an ion source means capable of generating ions with said ions leaving said ion source means in

the form of an ion efflux having an energy of about 50 eV or less;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets comprised of a plurality of materials;

(d) biasing each of said targets negative relative to ground;

(e) directing said ion efflux upon said targets so as to sputter material therefrom; and

(f) controlling said biases so as to deposit on said substrate a film comprised of a predetermined composition of said materials.

18. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing an ion source means capable of generating ions with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets comprised of a plurality of materials;

(d) biasing each of said targets negative relative to ground;

(e) directing said ion efflux upon said targets so as to sputter material therefrom; and

(f) controlling said biases in a time-sequential manner so layers of different compositions of said

materials are deposited sequentially on said substrate.

19. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing an ion source means capable of generating ions with said ions leaving said ion source means in the form of an ion efflux having an energy of about 50 eV or less;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets comprised of a plurality of materials;

(d) biasing each of said targets negative relative to ground;

(e) directing said ion efflux upon said targets so as to sputter material therefrom; and

(f) controlling said biases in a time-varying manner so that the deposit on said substrate varies in a continuous manner from an initial composition comprised of respective said target materials to a following and different composition comprised of said materials.

20. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing a plurality of ion source means capable of generating ions with said ions leaving each of said ion source means in the form of an ion efflux having an energy of about 50 eV or less and wherein said

efflux has an ion current that is independently controllable;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets comprised of a material;

(d) biasing each of said targets negative relative to ground;

(e) directing said ion efflux upon said targets so as to sputter said material therefrom and deposit said material on said substrate; and

(f) locating said targets relative to said substrate and controlling said ion currents and said negative biases so as to deposit upon said substrate a film of said material having a thickness with a predetermined thickness distribution.

21. A method in accordance with claim **20** comprising the further steps of:

(g) locating a plurality of sensors to provide measurements of said thickness at a plurality of locations on or near said substrate;

(h) making comparisons of said measurements of said thickness; and

(i) using said comparisons to control said ion currents of said sources and said biases of said substrates.

22. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing a plurality of ion source means capable of generating ions with said ions leaving each of said ion source means in the form of an ion efflux having an energy of about 50 eV or less and wherein said efflux has an ion current that is independently controllable;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets composed of a plurality of materials;

(d) biasing each of said targets negative relative to ground;

(e) directing said ion efflux upon said targets so as to sputter material therefrom and deposit said material on said substrate; and

(f) controlling said ion currents and said negative biases so that a predetermined composition of said materials is deposited upon said substrate.

23. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing a plurality of ion source means capable of generating ions with said ions leaving each of said ion source means in the form of an ion efflux having an energy of about 50 eV or less and wherein said efflux has an ion current that is independently controllable;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets composed of a plurality of materials;

(d) biasing each of said targets negative relative to ground;

(e) directing said ion efflux upon said targets so as to sputter material therefrom and deposit said material on said substrate; and

(f) controlling said biases and said ion currents in a time-sequential manner such that layers of different compositions of said materials are deposited sequentially on said substrate.

24. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing a plurality of ion source means capable of generating ions with said ions leaving each of said ion source means in the form of an ion efflux having an energy of about 50 eV or less and wherein said efflux has an ion current that is independently controllable;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets composed of a plurality of materials;

(d) biasing each of said targets negative relative to ground;

(e) directing said ion efflux upon said targets so as to sputter material therefrom and deposit said material on said substrate; and

(f) controlling said biases and said ion currents in a time-varying manner such that the deposit on said substrate varies in a continuous manner from an initial composition comprised of respective said target materials to a following and different composition of said materials.

25. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing a plurality of ion source means capable of generating ions with said ions leaving each of said ion source means in the form of an ion beam having an energy and an ion current that are independently controllable;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets comprised of a material;

(d) directing said ion beams upon said targets so as to sputter said material therefrom and deposit said material on said substrate; and

(e) locating said targets relative to said substrate and controlling said ion energies and said ion currents so as to deposit upon said substrate a film of said material having a thickness with a predetermined thickness distribution.

26. A method in accordance with claim 20 comprising the further steps of:

(g) locating a plurality of sensors to provide measurements of said thickness at a plurality of locations on or near said substrate;

(h) making comparisons of said measurements of said thickness; and

(i) using said comparisons to control said ion currents and said biases.

27. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing a plurality of ion source means capable of generating ions with said ions leaving each of said ion source means in the form of an ion beam having an energy and an ion current that are independently controllable;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets comprised of a plurality of materials;

(d) directing said ion beams upon said targets so as to sputter said materials therefrom and deposit said material on said substrate; and

(e) controlling said ion energies and said ion currents in a time-sequential manner such that layers of different compositions of said materials are deposited sequentially on said substrate.

28. A method for sputtering material within a vacuum chamber, the method comprising the steps of:

(a) providing a plurality of ion source means capable of generating ions with said ions leaving each of said ion source means in the form of an ion beam having an energy and an ion current that are independently controllable;

(b) providing at least one deposition substrate;

(c) providing a plurality of stationary targets comprised of a plurality of materials;

(c) directing said ion beams upon said targets so as to sputter said materials therefrom and deposit said material on said substrate; and

(d) controlling said ion energies and said ion currents in a time-varying manner such that the deposit on said substrate varies in a continuous manner from an initial composition comprised of respective said target materials to a following and different composition of said materials.

29. Apparatus in accordance with Claims **1** through **5** and **10** through **28** wherein said ion source means comprises an end-Hall ion source.

30. Apparatus in accordance with Claims **1** through **28** wherein there is an additional ion source and the additional ion beam from said additional ion source is directed at said substrate.

31. Apparatus in accordance with Claims **1** through **28** wherein there is an additional ion source and the additional ion beam from said additional ion source is directed at said

substrate and wherein the ions in said additional ion beam react with said material or materials being deposited upon said substrate.

32. Apparatus in accordance with Claims 1 through 28 wherein a reactive gas is introduced into said vacuum chamber.